

# Bone remodeling to correct maxillary deficiency after growth cessation

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## ABSTRACT

This case report presents a 22-year-old girl with class III malocclusion due to maxillary deficiency. The patient was referred for presurgical orthodontics; however, she rejected the surgery. This case was treated by means of Tongue appliance and slow palatal expansion, followed by lower fixed appliance, reverse chin cup, and upper fixed appliance. Tongue appliance and slow palatal expansion were used at the beginning of the treatment. After 6 months, reverse chin cup and lower fixed appliance were added. Six months later reverse chin cup was removed and upper fixed appliance was mounted. Positive overbite and over jet were achieved after 24 months of active treatment. Nasolabial angle also showed improvement. Nonsurgical treatment of adult class III patients is a difficult procedure; however, this patient was treated nonsurgically.

**Key words:** Bone remodeling, class III malocclusion, growth modification, maxillary deficiency, nonsurgical treatment

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## INTRODUCTION

Skeletal class III malocclusion is one of the most difficult discrepancies to correct. It can be defined as skeletal facial deformities characterized by maxillary retrusion, mandibular prognathism, or a combination of both.<sup>[1]</sup> Ellis and McNamara found that 30% of the class III subjects had maxillary retrusion and mandibular prognathism.<sup>[2]</sup> The etiology of this malocclusion varies from case to case. Hereditary factors such as the Hapsburg chin and environmental influences such as missing teeth can be mentioned as two major implicated factors of class III malocclusions.

A series of treatment approaches can be found in the literature regarding orthopedic treatment in class III malocclusion with maxillary deficiency in growing patients. Delaire<sup>[3]</sup> developed the orthopedic facemask to stimulate maxillary growth. Reverse-pull headgear was also used for treatment of this discrepancy.<sup>[4,5]</sup> The use of ankylosed primary canines as anchorage for maxillary orthopedics is a viable alternative method.<sup>[6,7]</sup> Recently, tongue appliance,<sup>[8-11]</sup> tongue plate,<sup>[12]</sup> miniplates,<sup>[13,14]</sup> bone-anchored maxillary protraction,<sup>[15-17]</sup> and miniscrew<sup>[18,19]</sup> have also been used for treatment of maxillary deficiency. As known, maxilla cannot be moved after growth cessation; therefore, the common belief is that treatment of adult patients will eventually need surgery.<sup>[20]</sup>

However, due to a number of environmental factors such as impacted canines, some adult patients can be treated nonsurgically. In this article, orthodontic treatment of an adult patient with maxillary deficiency due to impacted upper canines is presented.

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## CASE REPORT

A 22-year-old girl was initially referred by a Maxillofacial surgeon to an orthodontic office for presurgical orthodontic treatment planning for advancing of her maxilla. She had no medical problems and there were no signs of temporomandibular joint dysfunction. Her impacted upper right and left canines were extracted at 17 years of age.

Extraoral examination showed a retruded upper lip with higher than normal nasolabial angle [Figure 1].

Intraoral examination showed anterior and posterior crossbites and reverse overjet. The molars showed class I relationship; however, they had class III relationship due to the loss of upper left and right canines. Loss of upper left and right canines resulted in mesial migration of upper molars; thus, the relationship of molars changes from class III to class I malocclusion [Figures 2–4]. Cephalometric analysis confirmed skeletal class III and vertical growth pattern with maxillary deficiency [Table 1] [Figures 5 and 6].

### Treatment objectives

The treatment objectives for this patient were to:

- 1 – correct the deficient maxilla, ideally by moving it to a forward position;
- 2 – correct the anterior crossbite;
- 3 – correct the posterior crossbite;
- 4 – obtain an ideal overjet and overbite;
- 5 – provide functional intercuspation.

### Treatment alternatives

Operative maxillary advancement was considered as an alternative option. Another alternative treatment

**Table 1: Cephalometric analysis**

Cephalometric data	Pre-treatment	Post treatment
SNA (°)	80	83
SNB (°)	79	80
ANB (°)	1	3
GoGn/SN (°)	31	30
I/SN (°)	96	100
IMPA (°)	98	87
Interincisal (°)	134	145
Y-Axis (°)	66	65
Inclination (°)	85	87



Figure 1: Pretreatment profile view of the patient



Figure 2: Pretreatment intraoral photos of the patient



Figure 3: Pretreatment intraoral photos of the patient



Figure 4: Pretreatment intraoral photos of the patient

approach was surgically assisted maxillary expansion, followed by advancing the maxilla with facemask. Primarily, the patient was referred for the preoperative orthodontics; however, she rejected the surgery and insisted on orthodontic treatment. Therefore, after the patient signed the required consent forms to be treated orthodontically, it was decided to advance the maxilla by means of Tongue appliance 9,10, slow maxillary palatal expansion, and lower fixed appliance, followed by reverse chin cup<sup>[21]</sup> and upper fixed appliance.

### Treatment Progress

Tongue appliance 9,10 and jack screw mounted in the midline were used for 6 months in order to advance the maxilla and correct the posterior crossbite. The patient was instructed to open the screw of the palatal expansion 1/4 of a turn per week for 6 months. A tightly fitting and well-retained upper removable appliance was fabricated with Adams clasps on the upper first permanent molars and two C clasps were placed on the upper permanent central and lateral incisors. Long tongue cribs were placed in the palatal area between canine to canine. These cribs were long enough to cage the tongue and were adjusted to avoid traumatizing the floor of the mouth. After 6 months of wearing the tongue appliance, the occlusion was improved; afterward, the lower first premolars were extracted and the patient was banded and bonded with 0.22 standard edgewise appliance in

the lower arch [Figure 7]. At the same time, reverse chin cup<sup>[21]</sup> was added in order to reinforce the process of bone remodeling in the nasomaxillary complex. Tongue appliance combined with reverse chin cup was used for 6 more months. Afterwards, the reverse chin cup was removed and the treatment was continued with the tongue appliance combined with 0.22 standard edgewise appliance in the upper arch for 1 year [Figure 8].

### TREATMENT RESULTS

Positive overjet and overbite were achieved after 24 months of active treatment [Figures 9–11]. The post-treatment cephalometric radiograph tracing showed favorable increase of 3° and 2° in the Sella, Nasion, A point (SNA) and A point, Nasion, B point (ANB) angles [Table 1, Figures 12 and 13]. Nasolabial angle was improved and ideal overjet and overbite were achieved. The superimposition of pre and post-treatment cephalometric tracing on the anterior cranial base is shown in Figure 14.



Figure 5: Pretreatment OPG of the patient



Figure 6: Pretreatment lateral Cephalogram of the patient



Figure 7: Improvement after tongue appliance



Figure 8: Tongue appliance *in situ*



Figure 9: Post-treatment profile view of the patient



Figure 10: Post-treatment intra-oral photos of the patient



Figure 11: Post-treatment intra-oral photos of the patient



Figure 12: Post-treatment OPG of the patient



Figure 13: Post-treatment lateral Cephalogram of the patient

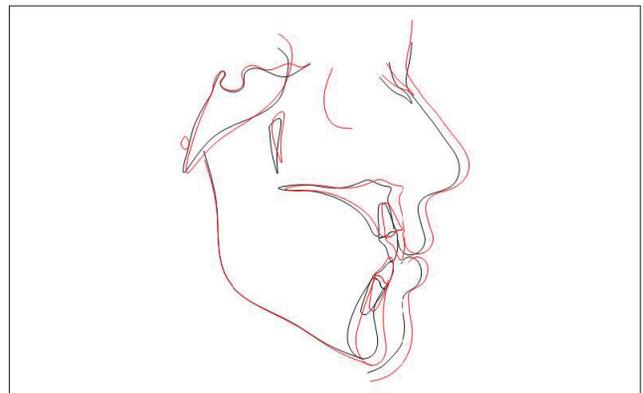


Figure 14: Superimposition in anterior cranial base at sella. Red= after treatment, black= before treatment

## DISCUSSION

The present case is about an adult patient with class III malocclusion due to maxillary deficiency. The age of

the patient made the treatment plan quite difficult. In this patient, the impacted canines acted as barrier to normal development of the maxilla. Thus, it was decided to move the maxilla forward by removing the impacted canines and applying concept of Wolff's law<sup>[22]</sup> on the maxilla. In fact, the cancellous bone of maxillary complex responds more to pressure and tension.<sup>[23]</sup>

Tongue appliance<sup>[9,10]</sup> was used in this case because when it is in the mouth a considerable pressure will be transmitted to the deficient maxilla. The mechanism of

this force is provided by the following ways:

1. The pressure of the tongue during swallowing might reach 5 pounds in each swallowing. The frequency of swallowing is about 500–1200 times in 24 h. This intermittent force is transferred through the tongue appliance to the deficient nasomaxillary complex.
2. The tongue generates a considerable force in its rest position while caged behind the cribs. These forces are transmitted by the tongue to the palatal cribs and finally to the nasomaxillary complex consequently pushing the maxilla to a forward position. The more anterior the tongue is, the greater the force will be. The more posterior the crib is, the greater the force will be.

Jack screw was used to expand maxillary arch and simultaneously loosen the maxillary sutures such as frontomaxillary, zygomaxillary, pterygomaxillary, and so on. This loosening along with the force action of the tongue facilitates the lateral and forward remodeling of the maxilla. The process continues by reverse chin cup. Advancing the maxillary complex has an impact on the upper dental arch and improves the lip position. Fixed appliance was used in the lower arch to improve the lower anterior inclination, which would affect the overjet and overbite.

The neutral zone is the area where the displacing forces of the lips and tongue are in balance. Presence of tongue appliance in mouth alters the neutral zone. In other words, since the tongue is caged by the crib it does not exert any forces on the lower incisors; thus, they are retroclined due to the pressure of the lips. After the tongue appliance is removed, tongue's pressure on the lower incisors will result in their proclination.

Treatment of the patient was continued by fixed orthodontics to correct axial inclinations (tip and torque)

## CONCLUSION

Maxillary deficiency was successfully corrected by means of tongue appliance, slow palatal expansion, lower fixed appliance, reverse chin cup, and upper fixed appliance.

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